Adaptable Autonomous Systems

Dr. Jason Stack

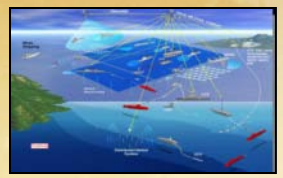
Revolutionary Research . . . Relevant Results

OFFICE OF NAVAL RESEARCH

Why Autonomy?

Not enough people to…

- Accomplish today's missions
  - Dull, dirty, & dangerous
  - The "how"
- Accomplish tomorrow's missions
  - Persistent, pervasive, perceptive
  - The "what"



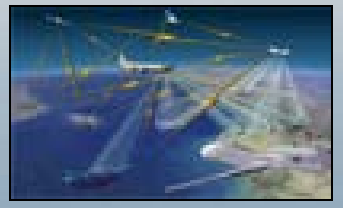
Multi-modal Data Mining

Mine Clearance

Data Analysis

Counter Asymmetric Threats & UxVs

Persistent Surveillance



Large Sensor Network Optimization

Autonomy Investment

- Advanced Technology Development
  - Prototype problem-specific *automated & autonomous systems*
- Applied Research
  - Focus domain-specific research combining *automation & autonomy*
- Basic Research
  - Foster broad, deep understanding & advancement in *autonomy*

Basic Research
Science of Autonomy

- Purpose: Establish multi-disciplinary, cross-department research in *autonomous behavior*

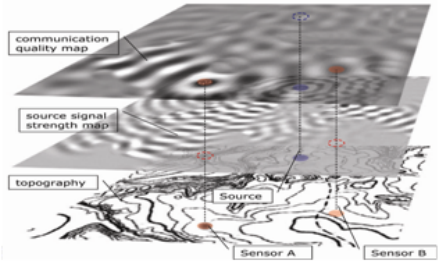
- Process: ONR & NRL SMEs defined 4 Focus Areas, NRE vetted, NWDC + NRE tabletop wargame

Program Officers: Dr Steinberg (lead), Dr Bello, Dr Brizzolara, Dr Kamgar-Parsi, Dr McKenna, Dr Paluszkiewicz and Dr Stack

Basic Research
Science of Autonomy

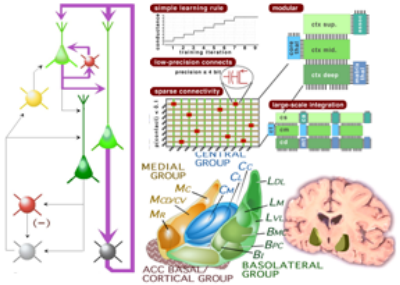
- 4 Focus Areas with articulated “hard problems”**
- Continual refinement of Focus Areas

Human/Unmanned Systems Collaboration



Perception & Intelligent Decision-Making

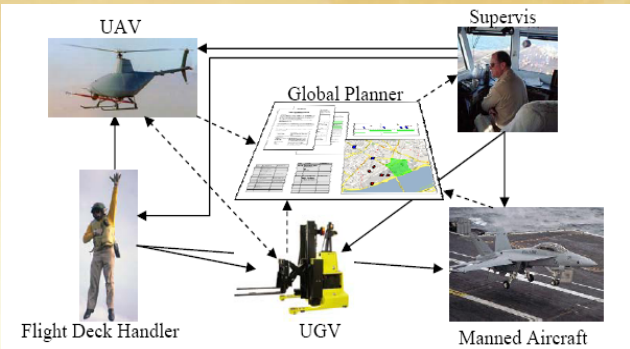
Scalable & Robust Distributed Collaboration



Intelligence Enablers & Architectures

**See ONR website, Office of Innovation report on “Autonomous Systems Innovation Summit”

Applied Research
Unmanned Air Systems (UAS)



Safe shipboard & airspace operations integrated with manned aircraft for naval missions

Control of large numbers of heterogeneous unmanned systems in complex airspaces

Program Manager

Dr Marc Steinberg

Sustainable operations in challenging weather & environmental conditions

Increased tactical role (cargo, casualty evac, force protection, "wingman" for dismounted marine, riverine)

Shared & distributed control to get UAS Services to the Tactical Edge

Applied Research
MCM Data Understanding

Program Officer

Dr. Jason Stack

Program Goals

Program Focus

	Decrease Tactical Timeline	Man out of the Minefield
Automation	Env characterization & performance estimation	Real-time ATR
Autonomous Behaviors	**Intelligent prep of the operational env (IPOE)**	Adaptive coverage vs. reacquire / identify
Knowledge Sharing	**Actionable tactical behaviors within mission objectives**	Assimilate tactical data into mission information
Human Interaction	Assist CO's adjudication of time, risk, etc	Architecture for supervision vice control

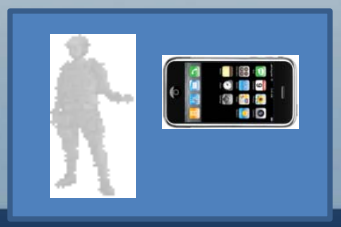
Advanced Development
Aerial Cargo Systems

Autonomous Aerial Cargo & General Utility Systems

- Intelligent autonomous capabilities for future aerial cargo / utility systems
- Timely, affordable, reliable, and shipboard-compatible supply, retrograde, and casualty evacuation
  - Landing at unprepared LZ under demanding conditions
  - Dynamic Mission Management enroute
  - Modular capabilities developed on open system Service Oriented Architecture
  - Novel human interfaces, to include optional manning

Program Officer

Mr. John Kinzer



3D Flash LADAR

Low Cost MMW Radar

Advanced Development
Large UUV Technologies

Product Description:
- Reliable Long Endurance UUV capable of 60+ days of operation in the Littorals.
- Program will develop the needed Autonomy, Energy, and Core UUV systems to operate in complex ocean environment near harbors, shore, and high surface traffic locations

Key Program Goals
- Double Current UUV Energy Density
- Autonomous in the Littorals:
- Open Architecture
- Open Ocean/Over the Horizon Operations

Warfighting Payoff:
- Enables realization of fully autonomous UUVs operating in complex near shore environments to increase capability.
- Cost effectively closes war fighter capability and capacity gaps in critical mission areas.
- Extends and multiplies the reach of the platform into denied areas and reduces platform vulnerability.

Program Officer

Mr. Dan Deitz

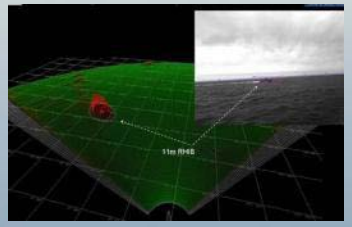
Advanced Development
USSV Autonomy

- Unmanned Sea Surface Vehicle (USSV) Program is developing intelligent autonomy for
  - Autonomous mission planning
  - Perception (based on EOIR and radar, with LIDAR to be added in the future)
  - Tactical behaviors (e.g. avoid obstacles, follow, intercept, etc)
  - Vehicle health monitoring
  - Reactive & deliberative autonomy

Program Officer

Dr. Bob Brizzolara

Example of MCM USV



Stereocamera tracking of 11m RHIB from USV.

Avoidance of static obstacles--bird's-eye view

Other Program Officers You Should Meet

Program	Program Officer	Code	Room
Machine Reasoning & Intelligence	Behzad Kamgar-Parsi	31	Fairfax
Bio-Inspired Autonomous Systems	Tom McKenna	34	Lincoln
Socio-Cognitive Architectures for AAS	Paul Bello	34	Lincoln
Science of Autonomy	Marc Steinberg	35	Jefferson
Autonomy of Mixed Initiative Large Teams	Martin Kruger	30	Arlington
Human Robotic Interaction	Tom McKenna	34	Lincoln
UAS Autonomous Collision Avoidance System (ACAS)	Robert Hintz	31	Fairfax
Autonomous Aerial Cargo / Utility System (AACUS)	John Kinzer	35	Jefferson
Unmanned Sea Surface Vehicle (USSV)	Bob Brizzolara	33	Roosevelt
UGV Autonomy / Perception	Jeff Bradel & Keith Hammack	30	Arlington
Large Displacement UUV	Dan Deitz	32	Prince William
Undersea Warfare	Dave Johnson (ASW) & Tom Swean (MCM)	32	Prince William